Uitgegeven den
14. APR. 1938

PATENT SPECIFICATION

Application Date: June 6, 1936. No. 33996/35. 481,584

Complete Specification Accepted: March 7, 1938.

COMPLETE SPECIFICATION

Improvements relating to the Distillation of Coal and other Solid Carbonaceous Substances

We, FREDERICK WILLIAM SALISBURY-JONES, of 8, Princes Street, London, E.C.2, of British Nationality, and ROBERT NISBET, of 47, Fitzjohn Avenue, Barnet, in the County of Herts, of British Nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly

to the said retort or retorts, a number of containers for the carbonaceous substance adapted to rest one upon another in the retort or retorts, and for each retort admission and discharge valves or closures for the upper and lower ends of the retort respectively, a container lowering device disposed at the lower end of the retort and comprising a series of container supports that are moved relatively to the path of the column of containers in the retort in such manner that the supports are caused in sequence to engage and support the column of containers while lowering it or permitting it to move downwardly under gravity and to disengage the containers singly or in small numbers from the column for discharge from the retort.

According to the invention, moreover, the containers may be introduced into the retort or carbonizing zone and may be withdrawn therefrom by way of sealing or closure valves permitting the introduction of the containers into and their withdrawal from the retort or carbonizing zone one or more at a time. The sealing or closure valves may conveniently be provided in the form of radial valves disposed each within a corresponding containing casing suitably positioned in relation to tort or carbonis- or the reception rs for the car- ıe and the same he valves may be with one or more m substantially ntainer or con- l into the valve, s may be posi- off a diameter and the exit from containers is dis- of the casing or casing. in the retort or dapted to be sup- on the other by comprising a or the said con- d to pass into and ... supporting the containers that are at any moment at the lower end of the retort or carbonising zone, and to lower the said containers one or more at a time into a position to be received into the discharge valve. The supports may conveniently take the form of arms which extend normally to the length of an endless chain or chains adapted to pass about suitable sprocket wheels or the like so positioned that in the movement of the chains the supports or arms are brought into the path of the containers present in the lower part of the retort or carbonising zone. By suitable disposition of the path of the chains or the like carrying the supports or arms in relation to the lower end of the retort or carbonising zone, it is possible to secure that the column of containers within the retort shall be supported by the supporting arms,

[*Price* 1/-]

ERRATUM

SPECIFICATION No. 481,584.

Page 5, line 47, *delete* " means "

THE PATENT OFFICE,
May 18th, 1938.

PATENT SPECIFICATION

Application Date: June 6, 1936. No. 33996/35. **481,584**

Complete Specification Accepted: March 7, 1938.

COMPLETE SPECIFICATION

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THE PATENT OFFICE,
May 13*th*, 1938.

to the said retort or retorts, a number of containers for the carbonaceous substance adapted to rest one upon another in the retort or retorts, and for each retort admission and discharge valves or closures for the upper and lower ends of the retort respectively, a container lowering device disposed at the lower end of the retort and comprising a series of container supports that are moved relatively to the path of the column of containers in the retort in such manner that the supports are caused in sequence to engage and support the column of containers while lowering it or permitting it to move downwardly under gravity and to disengage the containers singly or in small numbers from the column for discharge from the retort.

According to the invention, moreover, the containers may be introduced into the retort or carbonizing zone and may be withdrawn therefrom by way of sealing or closure valves permitting the introduction of the containers into and their withdrawal from the retort or carbonizing zone one or more at a time. The sealing or closure valves may conveniently be provided in the form of radial valves disposed each within a corresponding containing casing suitably positioned in relation to

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This invention relates to the distillation of coal and other solid carbonaceous substances.

The invention has among its objects to produce a coked product that has desirable qualities, to effect the distillation of carbonaceous substances in relatively thin layers, to provide apparatus whereby the distillation may be carried on as a continuous process, and generally to provide improved apparatus for effecting the distillation of the substances that are in question.

The invention consists in apparatus for effecting the distillation of coal and other carbonaceous substances, more particularly at low temperature, comprising a setting, one or more upstanding retorts disposed in the setting, means in the setting for applying heat under regulation to the said retort or retorts, a number of containers for the carbonaceous substance adapted to rest one upon another in the retort or retorts, and for each retort admission and discharge valves or closures for the upper and lower ends of the retort respectively, a container lowering device disposed at the lower end of the retort and comprising a series of container supports that are moved relatively to the path of the column of containers in the retort in such manner that the supports are caused in sequence to engage and support the column of containers while lowering it or permitting it to move downwardly under gravity and to disengage the containers singly or in small numbers from the column for discharge from the retort.

According to the invention, moreover, the containers may be introduced into the retort or carbonizing zone and may be withdrawn therefrom by way of sealing or closure valves permitting the introduction of the containers into and their withdrawal from the retort or carbonizing zone one or more at a time. The sealing or closure valves may conveniently be provided in the form of radial valves disposed each within a corresponding containing casing suitably positioned in relation to the inlet or exit of the retort or carbonising zone, and provided for the reception of one or more containers for the carbonaceous material at one and the same time. For this purpose the valves may be provided as drums each with one or more spaces therein of a form substantially following that of the container or containers to be introduced into the valve, and such space or spaces may be positioned diametrically or off a diameter according as the inlet of and the exit from the valve casing for the containers is disposed off the diameter of the casing or on the diameter of the casing.

The containers within the retort or carbonising zone are adapted to be supported one resting upon the other by lowering mechanism comprising a plurality of supports for the said containers which are caused to pass into and out of the position for supporting the containers that are at any moment at the lower end of the retort or carbonising zone, and to lower the said containers one or more at a time into a position to be received into the discharge valve. The supports may conveniently take the form of arms which extend normally to the length of an endless chain or chains adapted to pass about suitable sprocket wheels or the like so positioned that in the movement of the chains the supports or arms are brought into the path of the containers present in the lower part of the retort or carbonising zone. By suitable disposition of the path of the chains or the like carrying the supports or arms in relation to the lower end of the retort or carbonising zone, it is possible to secure that the column of containers within the retort shall be supported by the supporting arms,

and that in the passage of the chains or the like about the lowermost sprocket wheel or the like the weight of the column of containers is relieved from the lowermost container which is then free to be disengaged from the corresponding supports or arms and to be delivered to the discharge valve.

Alternatively the supports or arms may be carried by a wheel of large size similar to a sprocket so set in relation to the lower end of the retort or carbonising zone that the supports or arms are caused to have a relative movement in relation to the containers in the lower part of the retort or carbonising zone, in such manner that the supports or arms as they are carried to the lower side of the wheel are caused to relieve the lowermost container, of the weight of the column of containers within the retort or carbonising zone. Other means having the same purpose may be used without departing from the invention.

According to the invention, moreover, the mechanism provided with the supports or arms is caused to co-operate with an elevating conveyor by which the containers, after discharge of their contents of the solid residue of distillation, are returned to the upper end of the retort or carbonising zone for recharging in the manner hereinbefore described. The said conveyor is advantageously in the form of an endless chain conveyor that is excluded entirely from the heat of the retort or carbonising zone by the presence of the inlet and discharge valve, and is caused to travel for the greater part of its length in a position parallel to the length of the retort or carbonising zone.

According to the invention, moreover, such chain conveyor or the like is caused to have a speed of travel for the containers that is in excess of that of the mechanism provided for the supports or arms upon which the column of containers within the retort or carbonising zone are supported, so that the return of the discharged containers to the upper end of the retort or carbonising zone may be effected rapidly and a lesser number of containers than would otherwise be the case be required.

The invention further comprises the features hereinafter described.

The invention is illustrated, by way of example, in the accompanying drawings which illustrate a construction of the retort plant according to the invention.

Figure 1 is a side elevation, partly in section, of the plant.

Figure 2 is an elevation at right angles to Figure 1.

Figure 3 is a side elevation of the retort, to a larger scale.

Figure 4 is a plan view of the retort partly in section, and to an enlarged scale.

Figure 5 is a fractional elevation of a part of the upper end of the retort to the enlarged scale and taken on the line 5—5 of Figure 4.

Figure 6 is a cross-sectional elevation of part of the lower end of the retort, to a slightly reduced scale.

Figure 7 is a sectional elevation of a section of the retort.

Figure 8 is a side elevation of a container for the substance to be treated.

Figure 9 is a sectional plan view of the container as shown in Figure 8, taken on the line 9—9 of Figure 8.

Figure 10 is an end elevation of the container.

Figure 11 is a sectional elevation of the mechanism below the retort, to a scale larger than that of Figures 1 and 2.

Figure 12 is a sectional plan view of the casing of the container-supporting mechanism and of the lower extension of the retort.

Figure 13 is a sectional elevation of the casing of the container-supporting mechanism.

Figure 14 is a view in elevation of the lower extension of the retort.

Figure 15 is a sectional elevation of a valve casing and valve.

Figure 16 is a cross-sectional elevation of the valve and valve casing.

Figure 17 is a sectional elevation of the charging mechanism at the upper end of the retort and of the inlet valve, to the scale of Figure 11.

In carrying the invention into effect as illustrated in the accompanying drawings, in the construction of a plant adapted to operate for the low temperature distillation of coal, upon a suitable vertically disposed lattice frame 1, there is mounted, for example, at a position about 15 feet from the ground level, the brickwork setting 2 for a vertical retort 3, the said setting extending upwardly for about 30 feet. Such setting is provided with a plurality of heating flues extending in any suitable arrangement, and provided either for the combustion of gaseous fuel at the lower end of the flues, or for the introduction of heating gases from some exterior source. The flues are provided with suitable dampers or other means for the control of the temperature conditions at different elevations along the retort. The retort proper is provided in the form of a series of sections of hollow open ended metal elements having an oblong cross-section, for example 2 feet in length and 6 inches in width, the ends of the cross-section being of circular or simi-

lar smooth curvature and the sections being provided flanged at each end for the formation of connections between them or with other elements of the plant. The lower section of the retort is provided with a footstep or base 4 by which the whole of the retort is supported solely at the lower end upon the metal frame 1, thus to permit free expansion under heat.

The lateral walls of the retort are advantageously formed with a pair of rubbing strips or rails 5 (Figures 4 to 7) by which the containers for the charge may be guided through the retort in their downward passage. The upper end of the retort is provided with an inlet fitting 6 that is adapted to carry the casing of the container inlet valve, as hereinafter described, and is formed with an offtake 7 for the gases and vapours of distillation, and the retort together with the said valve casing is adapted for vertical movement under expansion in relation to the means whereby the containers are introduced into the inlet valve, and by which the containers are charged with the carbonaceous material, also as hereinafter described. The said valve casing may be disposed immediately in line with the retort, or the said fitting may be provided of a form such that the valve casing is disposed off the centre line of the retort.

The setting 2 is advantageously adapted to provide a maximum temperature of for example 650° C., which temperature may be uniform from the top to the bottom of the retort 3, or may vary, according to the setting of the dampers in the flues at different elevations along the retort. Under the conditions of operation the temperature within the retort is maintained at about 550° C. as the maximum temperature.

The containers 8 (Figures 8 to 10) for the carbonaceous material to be treated are provided of a cross-sectional form substantially corresponding to that of the retort, but of such size or area as to allow adequate clearance and of a shape which tapers slightly in both directions towards the bottom of the container, which is advantageously formed with a longitudinal opening that is closed by a false bottom 9, preferably provided with projecting studs or knobs 10 by which it may be manipulated. Each container is to be guided, where necessary, within suitable guideways, and for this purpose at each end of the container there is provided a metal fitting 11 having a longitudinal middle rib 12, and at the lower end a shoe 13 substantially following the curvature of the lower end of the container. At the upper end of the container the fittings 11 are connected by rubbing strips 14 extending along the upper lateral edges of the container, and at an intermediate position towards the upper end each fitting is provided with an outstanding stud or trunnion 15 for a purpose to be hereinafter described. The fittings 11 at the two ends of the container are advantageously stiffened by diagonal members 16 extending across the exterior of the lateral walls of the container and welded or otherwise secured to the fittings 11 which themselves are preferably welded to the container.

As hereinbefore stated, the charged containers 8 are adapted to be supported within the retort 3 in their passage through it by a mechanism provided at the lower end, one container being supported upon another by the shoes 13 of the first resting upon the upper ends of the fittings 11 of the second, and the containers resting laterally against the rubbing strips 5 of the retort by one of the rubbing strips 14.

The supporting mechanism is contained within a casing 17 (Figures 11 to 13) that is closed except in the direction of the retort and is advantageously formed into two lateral compartments 18 that are connected by transverse hollow sleeves 19 and are open at the sides 20. The casing 17 is connected by flanges about the openings 20 to a flange or lateral face 22 of a lower extension 21 of the retort through which the containers 8 emerge. The said face 22 of the extension 21 is provided with longitudinal openings 23 that register with the openings at the sides 20 of the casing 17. The extension 21 is jacketted on the remaining sides for the passage of a cooling medium, or, if necessary, a heating medium. It is further provided on the inner side of the lateral walls with guides 24 for the trunnions 15 of the containers 8.

The casing 17 serves to receive in the compartments 18 two pairs of sprocket wheels 25 for the guidance of endless chains 26 that are provided at determined intervals with outwardly extending supporting arms 27 for the trunnions 15 of the containers 8. The sprocket wheels 25, and thus the chains 26, are so disposed that the arms 27 of the respective pairs of chains in their travel around the sprocket wheels are caused to follow a path which is at an acute angle to the longitudinal plane of the retort, that is to say, to the plane of the guides 24, so that the arms 27, in moving downwardly, pass into the path of the containers within the retort extension. One pair of sprocket wheels may be replaced by plain wheels.

The bearings 28 of the spindles 29 for the sprocket wheels 25 are supported upon carrier members 30 conveniently in the

form of channel or other section metal, advantageously so provided within the casing 17 that the position or inclination of the path of the endless chains 26 in relation to the guides 24 of the retort extension 21 may be varied, while at the position at which the arms 27 of the endless chains 26 are caused to take up the weight of the column of the containers 8 within the retort, the chains 26 are supported against the pressure of the arms by suitable skid bars 31 which also may be adjustably positioned within the casing 17.

At a position at which the endless chains are caused to pass around the lower sprocket wheels 25, the direction of the lower extension of the retort is advantageously diverted slightly away from the chains 26, so that the containers 8 in their continued movement are diverted to the lower valve casing containing the discharge valve.

It will be understood that the spacing of the arms 27 of the endless chains 26 is such that when the chains are passing along the straight path inclined to the guides 24 of the retort extension 21, the arms 27 pass below the trunnions 15 of the containers 8 within the lower extension of the retort, and take up the weight of the column, and in the continued movement of the chains around the lower sprockets 25, by reason of the increased distance between the arms which results from the curvature of the chains, the lowermost container 8 is relieved of the weight of the column of containers and is at the same time disengaged from the supporting arms 27 to fall by gravity into the discharge valve.

The inlet and discharge valves for the containers (Figures 11, 15, 16 and 17) are substantially similar in construction. The casing 32 comprises a cylindrical drum having end closure plates 33, 34, one of which, 33, is provided with a cylindrical recess 35 at the centre for the reception of a stub spindle 36 at one side of the valve 37, while the other cover plate, 34, is provided with a gland and stuffing box 38 for the passage of the spindle 39 of the valve by which movement is imparted thereto from suitable driving gear. The casing 32 of the valve is provided with two openings 40, 41 having suitable flange-connecting fittings for connection to the retort or other element to which the casing is applied, and such openings are advantageously offset from a diameter. The drum 37 forming the valve which is adapted to rotate within the casing 32 and completely to fill the casing is provided with a longitudinal through space or pocket 42 for the reception of a single container 8 together with the fittings 11 applied thereon. In the oscillation of the drum 37 the said space 42 is brought into alignment first with the inlet opening 40 of the valve casing 32, and secondly into alignment with the outlet opening 41 of the casing. Thus when the space 42 is in alignment with the inlet opening 40, a container 8 may pass by gravity into the valve 37, the valve being closed against the exit 41, while when the valve has oscillated the inlet opening 40 of the casing is closed, and the space 42 within the valve is brought into alignment with the exit opening 41 of the valve casing, the inlet opening 40 being closed. The container 8 within the valve may then pass into the retort in the case of the inlet valve, or into the discharge casing in the case of the discharge valve.

When the valve 37 is in that position in which the space 42 therein is in alignment with the inlet opening 40 of the valve casing, it is also advantageously brought into alignment with a shallow recess 43 in the wall of the casing 32 of the valve, which recess may be formed by outwardly diverting the wall of the casing. Such recess or depression forms a striking bed for the incoming container, and since it is recessed from the wall of the valve any damage to the surface that results from the impact of the containers does not affect the efficiency of the valve as a gas-tight element. The recess or depression may be lined with a suitable substance, such as a relatively soft metal, to break the shock of the containers.

The discharge valve at the lower end of the extension 21 of the retort is provided to discharge the containers 8 into a casing 44 (Figures 1 and 11) having a downwardly inclined lower wall and provided on the lateral walls with guides 45 for the trunnions 15 of the containers 8 by which the containers are guided into a position below the lowermost sprocket wheels 46 of the endless chains 47 of the elevator by which the discharged containers 8 are carried to the upper end of the retort. The said chain conveyer is provided with arms 48 similar to the arms 27 of the chains 26, but in view of the fact that the chains 47 of the elevator are driven at a higher rate of speed than the chains 26, the arms 48 are spaced at wider intervals. As the containers 8 pass below the said sprocket wheels 46 they are engaged by the arms 48 of the chain conveyer and carried around the sprocket wheel, while their trunnions 15 are still in engagement with the guides 45 and so that they are inverted over a discharge opening 49 through which the contents of the containers may discharge into a suitable receptacle, such

as a truck.

The empty containers 8 are lifted by the conveyer to the upper end of the retort 3 where they again pass around the sprocket wheels 50 of the conveyer, their trunnions 15 still being in engagement with guides 45. On approaching the inlet valve the guides 45 are diverted from the sprocket wheels 50, so that the containers 8 now in their upright position may be led into a charging apparatus 51 with which the casing 32 of the inlet valve 37 is telescopically or otherwise engaged to permit expansion of the retort 3. The chains 47 of the chain conveyer after passing around the upper sprocket wheels 50 are carried downwardly over idle sprockets, to the lower sprocket wheels 46.

The charging apparatus for the containers 8 is conveniently provided in the form of an elevated bunker 52 positioned above the retort and fed by suitable means, such as a skip hoist 53. The said elevated storage bunker 52 is adapted to deliver a supply of the carbonaceous material to be treated into a second bunker 54, which advantageously is heated by waste gases, steam or other means, whereby the carbonaceous material is preheated before admission to the retort. At the lower end of the said heated bunker 54 the carbonaceous material is delivered into a calibrating device 55, whence it is discharged into a hinged shoot 56 that is caused to swing from a position below the calibrating device 55 into a position in which the contents may be discharged into the empty container 8 then resting upon the upper surface of the inlet valve 32.

It will be understood that the operation of the chain conveyer, the charging shoot, the inlet valve, the container supporting mechanism and the discharge valve may be effected from a common driving mechanism. Alternatively the drives may be effected independently, suitable means means being provided to secure synchronism.

It will further be understood that the setting 2 may be provided to serve for a plurality of retorts, and further that the retort may be provided to operate with a plurality of lines of containers.

Instead of providing containers to move vertically downward in their course through the retort or carbonising zone they may move in an inclined position, but as hereinbefore described it is preferred to provide for the movement of the containers vertically downward or at an inclined position at a small angle to the vertical.

The inverted containers may advantageously be returned from the lower position of their course to the upper charging position through a casing through which also that part of the chain conveyer may return downwardly adjacent the retort setting.

A star wheel or other device may be provided at a position immediately before that at which the discharging aperture is provided for checking the containers from overrunning the chain conveyer.

It will further be understood that the invention is not limited to the details of the construction of the retort, or the associated mechanisms where these are clearly capable of modification without departing from the scope of the invention.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Apparatus for effecting the distillation of coal and other carbonaceous substances, more particularly at low temperature, comprising a setting, one or more upstanding retorts disposed in the setting, means in the setting for applying heat under regulation to the said retort or retorts, a number of containers for the carbonaceous substance adapted to rest one upon another in the retort or retorts, and for each retort admission and discharge valves or closures for the upper and lower ends of the retort respectively, a container lowering device disposed at the lower end of the retort and comprising a series of container supports that are moved relatively to the path of the column of containers in the retort in such manner that the supports are caused in sequence to engage and support the column of containers while lowering it or permitting it to move downwardly under gravity and to discharge the containers singly or in small numbers from the column for discharge from the retort.

2. Apparatus according to Claim 1, wherein the lowering device for the column of containers comprises endless elements having the container supports mounted thereon in spaced relation and rotatable members with which the endless elements are engaged, the endless elements having part of their path of travel disposed in such proximity to the path of the column of containers in the retort and of such form that the container supports are caused in sequence to engage with and support the column of containers and to release the containers from the column in sequence.

3. Apparatus according to Claim 1 or 2, wherein the retorts are of elongated cross-section and the containers are of a similar cross-secton throughout their depth, affording a degree of clearance

within the retort such that the containers may pass freely through the retort.

4. Apparatus according to Claim 3, wherein the cross-section of each container decreases in area towards the bottom of the container.

5. Apparatus according to Claim 3 or 4, wherein the containers are charged and discharged through that side or end that lies uppermost in the retort.

6. Apparatus according to Claim 1, 2, 3, 4 or 5, wherein the containers are provided with fittings upon which the superposed containers may rest.

7. Apparatus according to Claim 1, 2, 3, 4, 5 or 6, wherein the containers are provided with projections by which they may be engaged by the supports of the lowering device.

8. Apparatus according to Claim 1 or 2, wherein the lowering device is contained in an enclosure that is applied to the lower part of the retort and is in communication with the retort for the passage into the latter of the container supports that are required to engage the column of containers.

9. Apparatus according to the preceding Claim, wherein at the lower end of the retort there is provided a lower extension of the retort having longitudinal openings through which the container supports of the lowering device may pass into engagement with the containers of the column of containers in the retort.

10. Apparatus according to Claim 1, wherein the admission and discharge valves or closures of the retort are provided in the form of drums rotatably mounted in enclosing casings, the casings being formed with inlet and outlet openings for the passage of the containers and the valve drums with transverse through spaces adapted for the reception of the containers and the passage of the containers through the valves.

11. Apparatus according to Claim 10, wherein the inlet and outlet openings of the casings and the spaces within the valve drums are so positioned that when the spaces are in register with the inlet openings they are out of register with the discharge openings.

12. Apparatus according to Claim 1, wherein the containers discharged from the retort through the discharge valve are caused to be emptied of the coke product and to be engaged by an elevating device by which they are moved to the upper end of the retort and fed to the charging position.

13. Apparatus according to Claim 12, in which the elevating device comprises endless flexible elements having spaced container supports thereon, the endless flexible elements being situated wholly exterior to the setting.

14. Apparatus according to Claim 12 or 13, wherein the elevating device is provided to operate at a higher rate of speed than the lowering device.

15. Apparatus for effecting the distillation of coal and other solid carbonaceous substances, substantially as hereinbefore described.

16. Apparatus for effecting the distillation of coal and other solid carbonaceous substances substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Dated this 9th day of December, 1935.

EDWARD EVANS & CO.,
40—43, Chancery Lane, London, W.C.2,
Agents for the Applicants.

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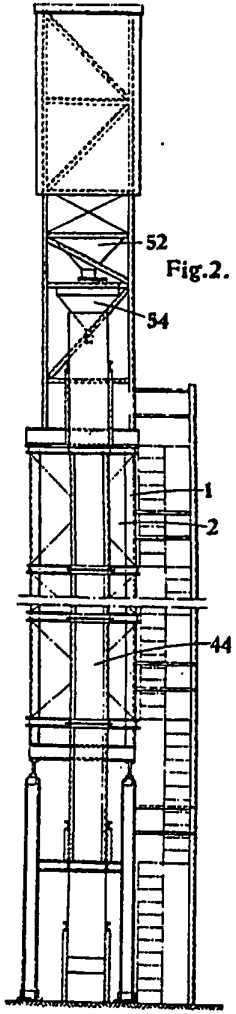

Fig.2.

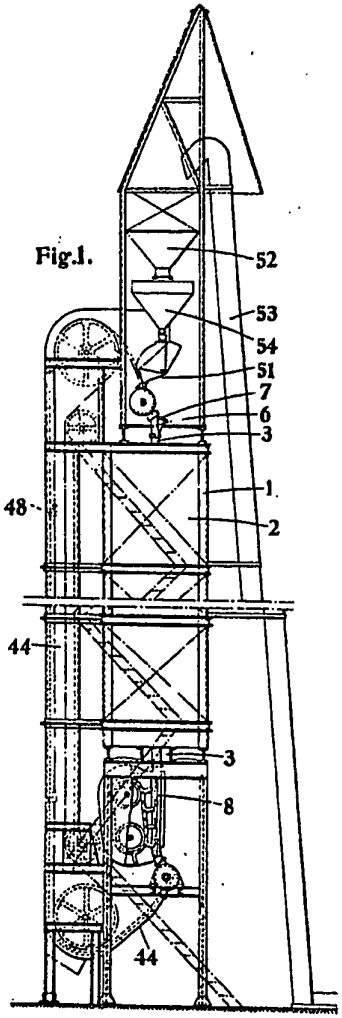

Fig.1.

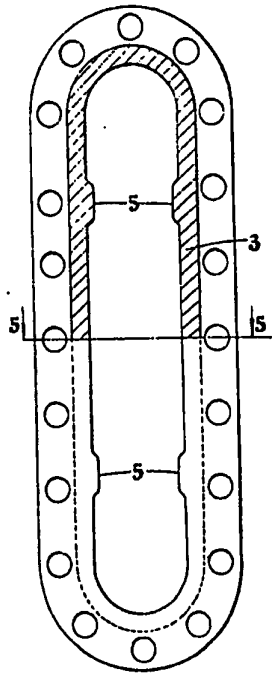

Fig. 4.

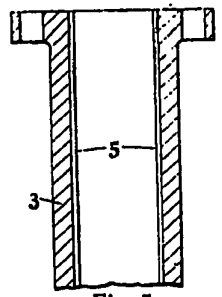

Fig. 5.

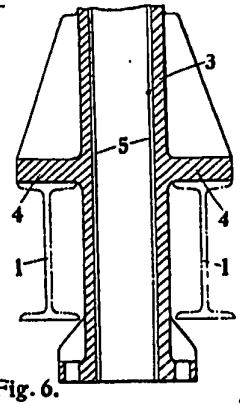

Fig. 6.

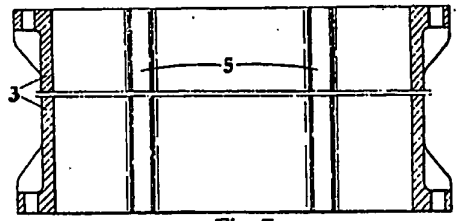

Fig. 7.

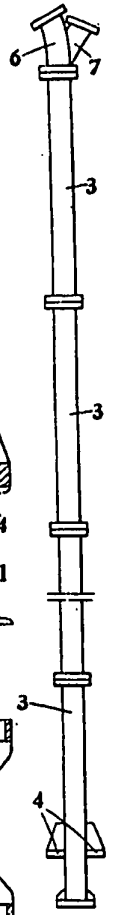

Fig. 3.

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[This Drawing is a reproduction of the Original on a reduced scale.]

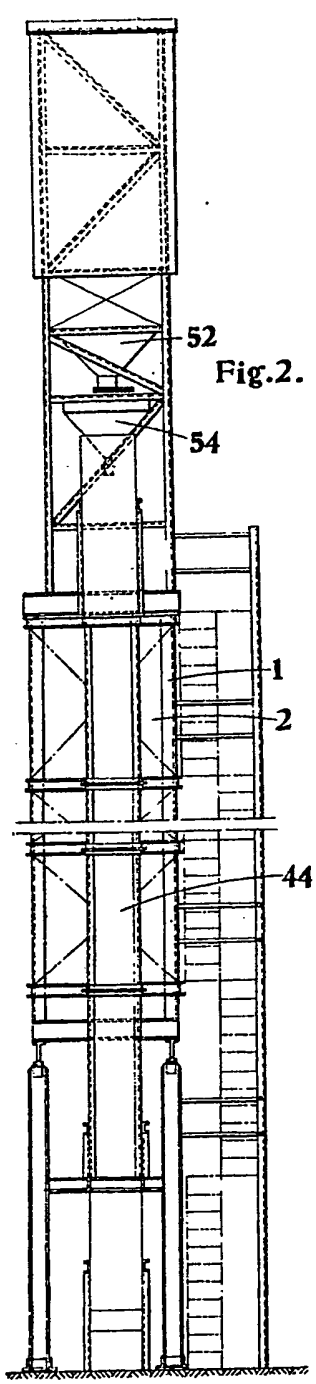
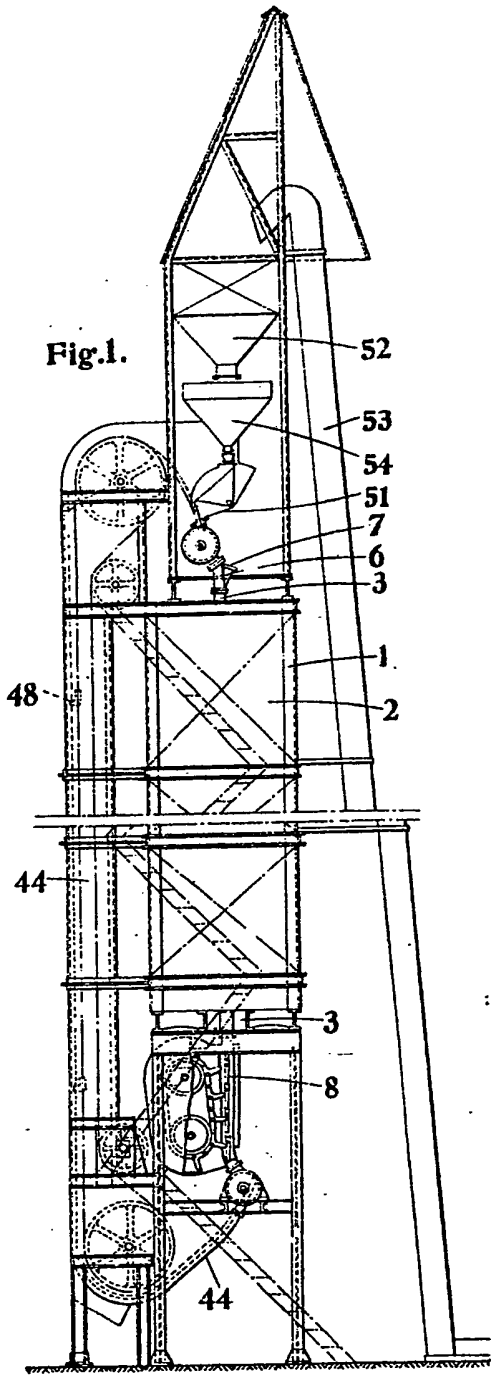
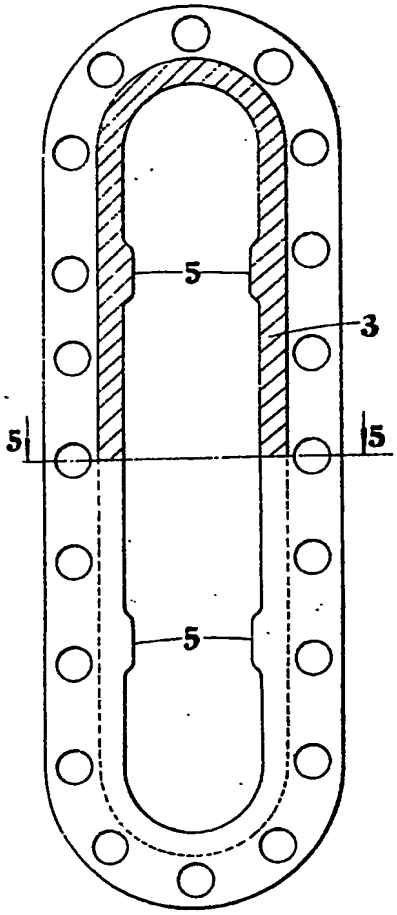


Fig.2.

Fig.1.





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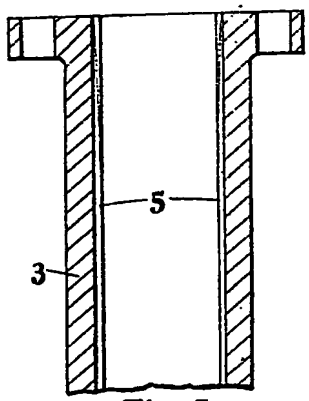

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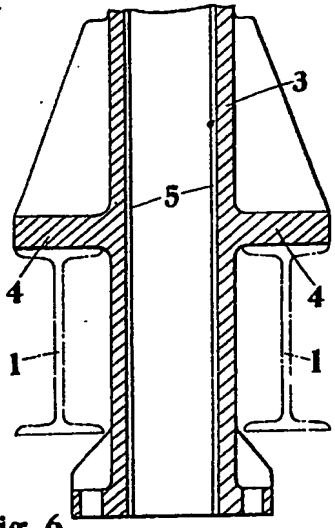

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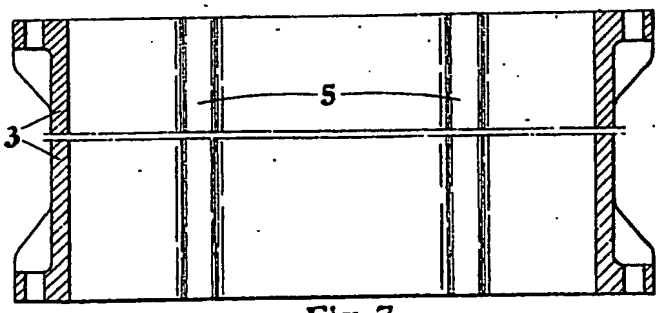

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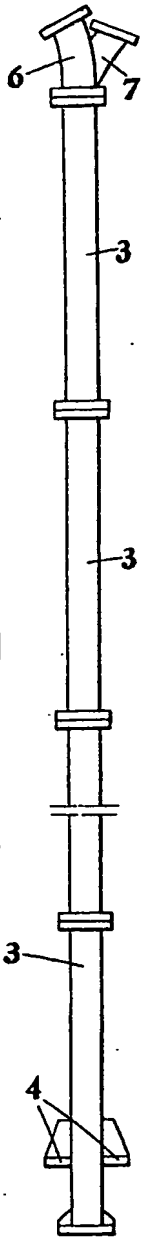

Fig. 3.

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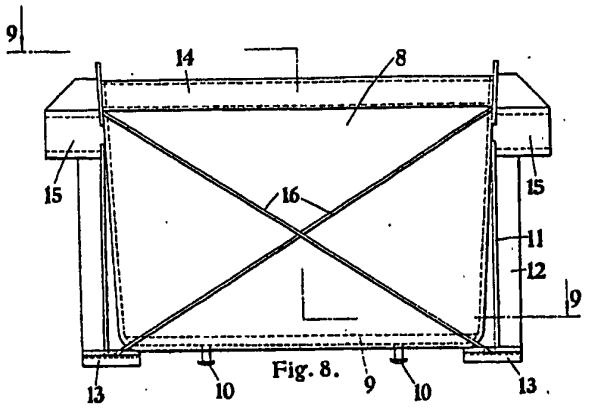

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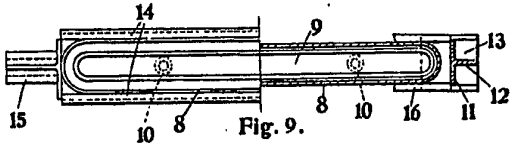

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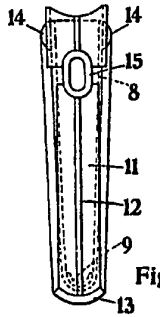

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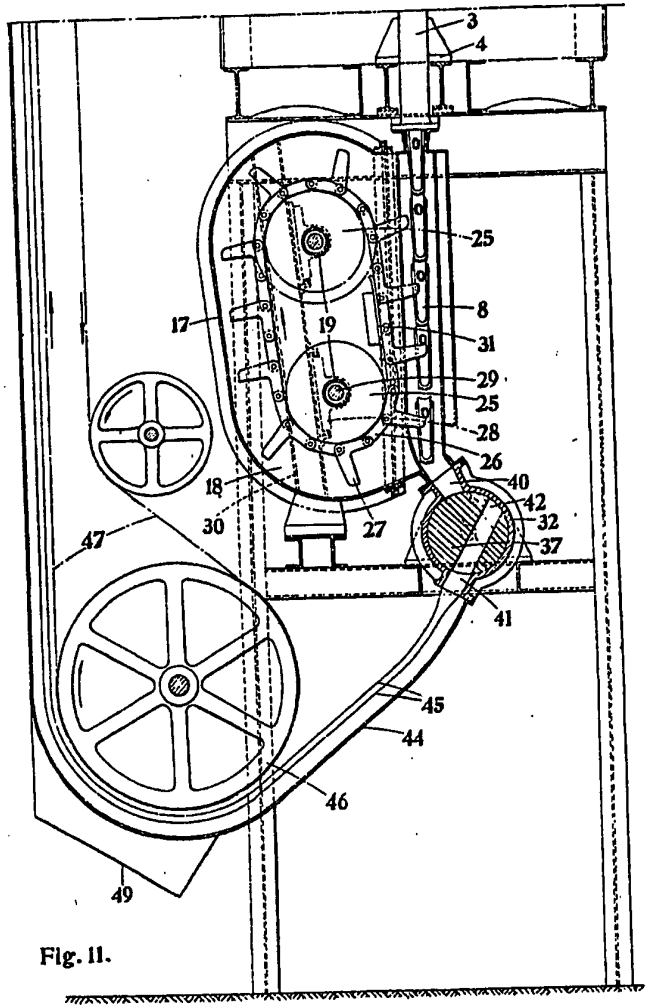

Fig. 11.

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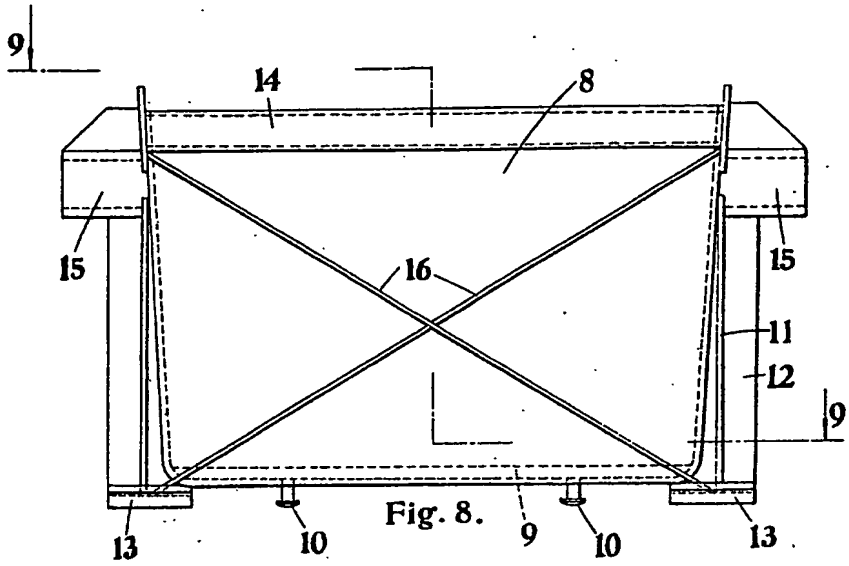

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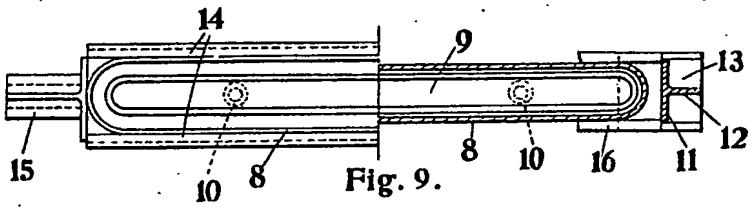

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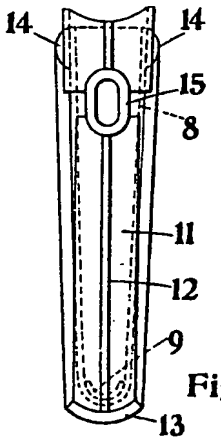

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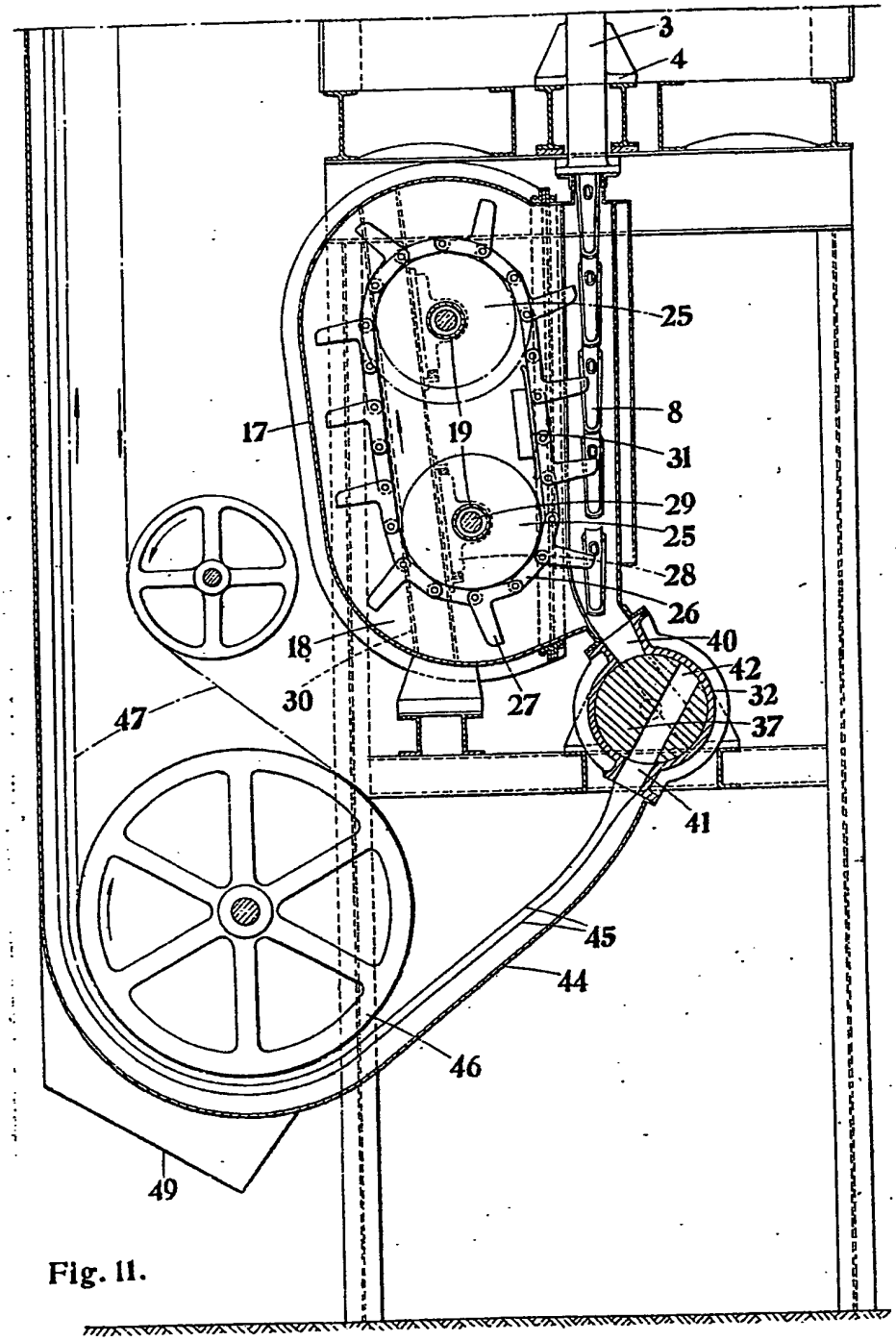

Fig. 11.

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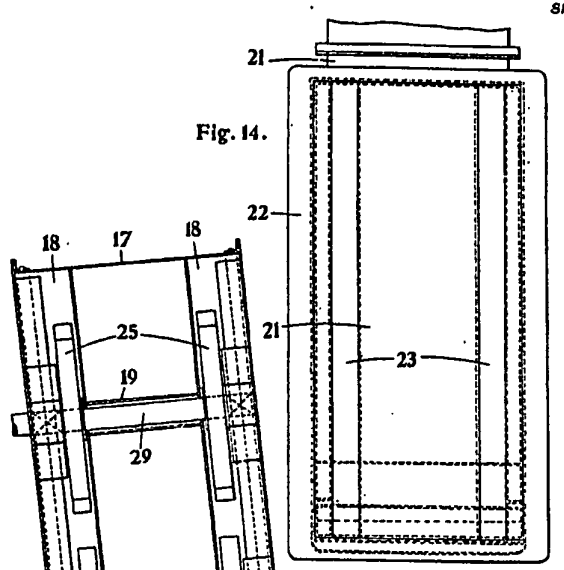

Fig. 13.

Fig. 14.

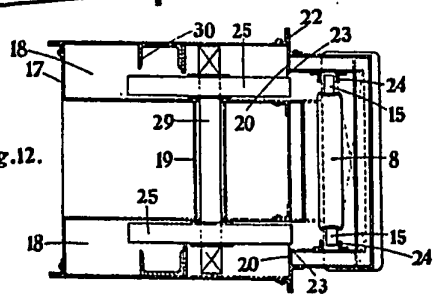

Fig. 12.

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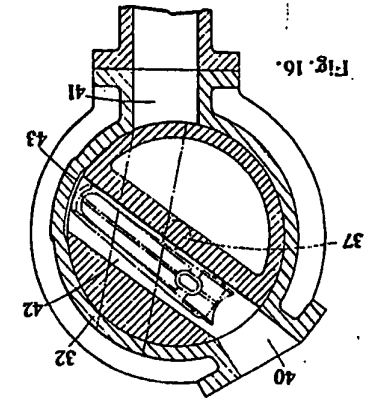
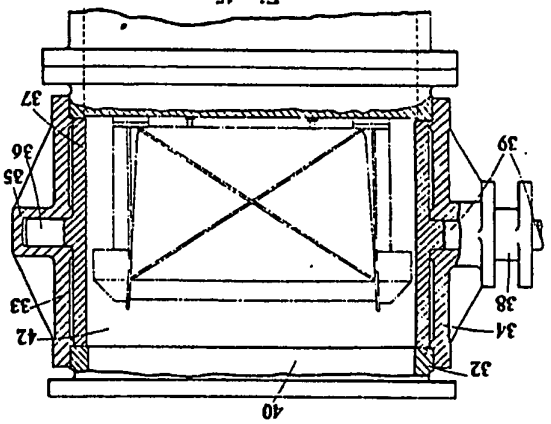


Fig. 16.



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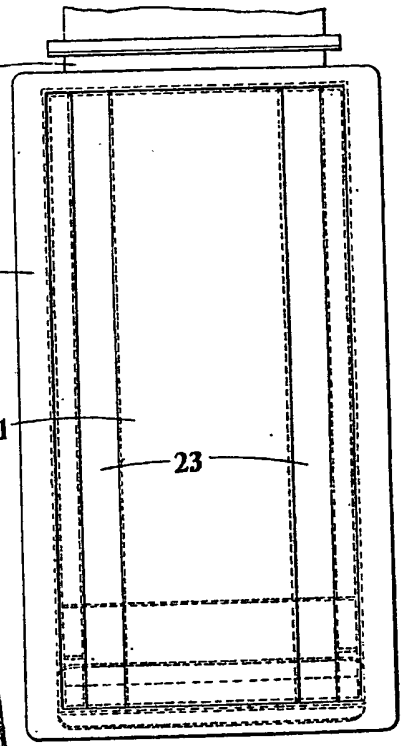

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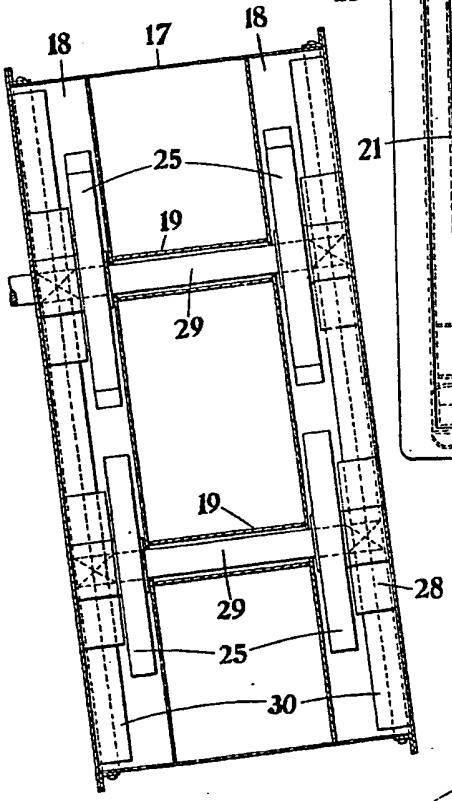

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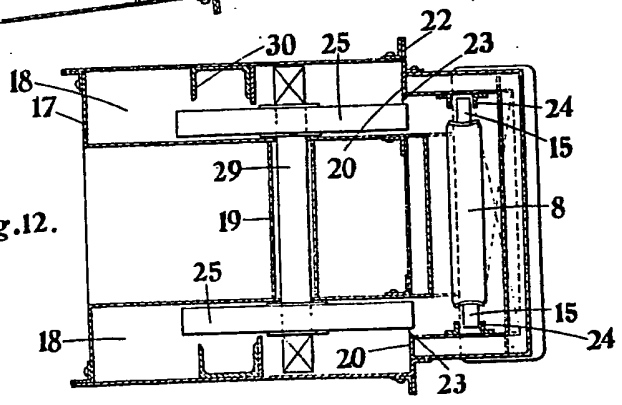

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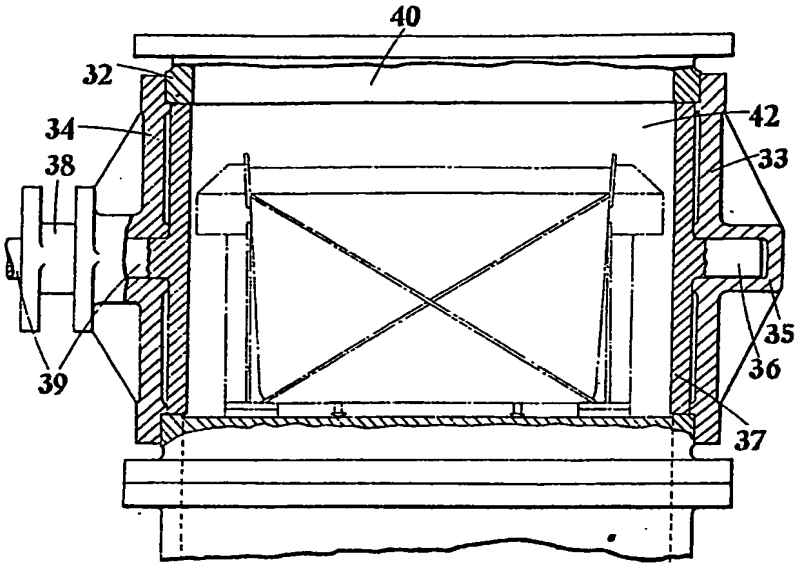

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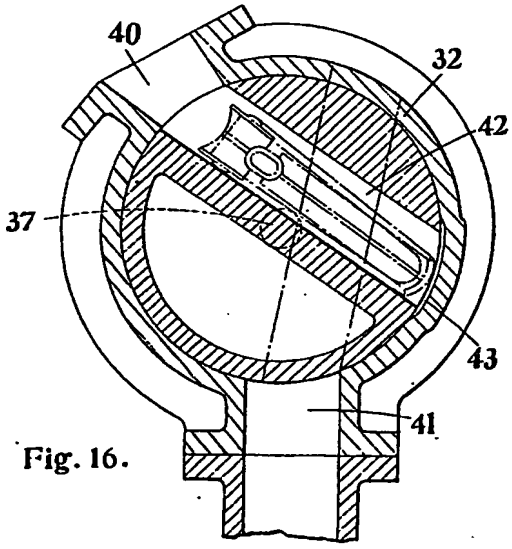

Fig. 16.

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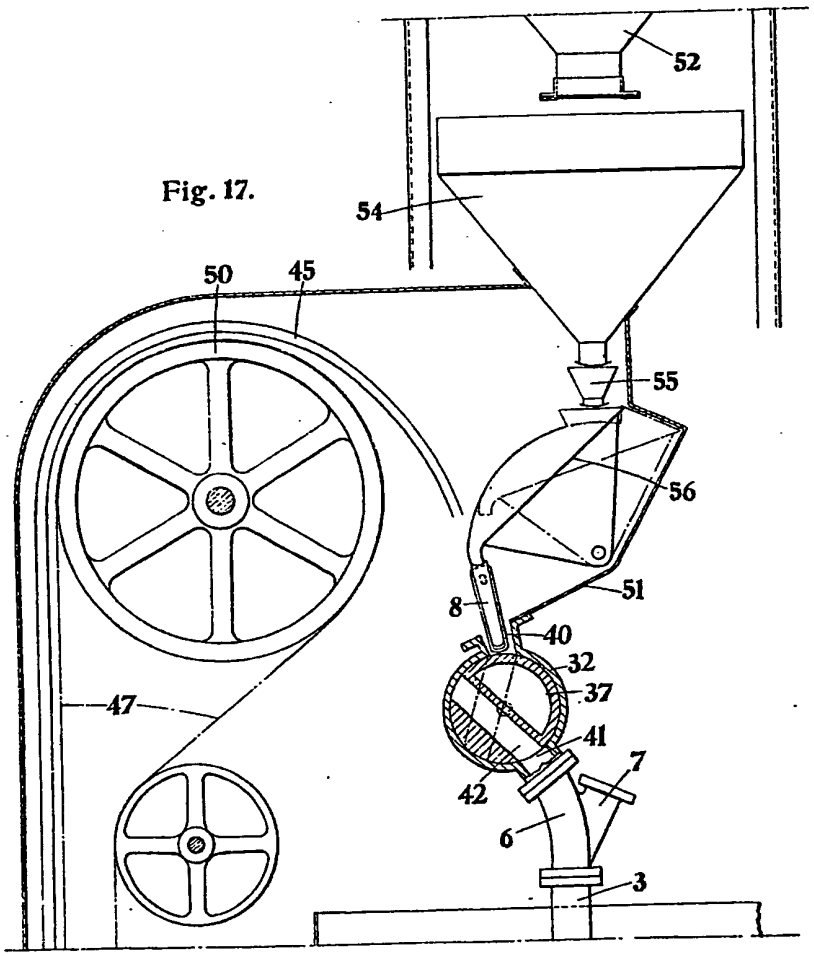
Fig. 17.



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